

Full Length Research Paper

Dynamic stratigraphy of upper cretaceous in Northwest Zagros (Kermanshah)-Iran

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Kermanshah is part of the structural zone of autochthonous Zagros in the boundary of Arabian and Iran plates. Stratigraphic sequence of upper cretaceous in two structural blocks of Kouh-e-Sefid in south and Kouh-e-Nesar in southwestern of Kermanshah up to Campanian stage was observed as similar sequence. There is a function of existing faults in area with distinct sedimentary condition in every block with each other, so that there is a reef sedimentary facies residue from collection of thick bed to massive limestone. While transitionally, in the block of Kouh-e-Sefid and Campanian, Marly limestone of Ilam formation changes to shales of Gourpi formation in Kouh-e-Nesar. In Maestrichtian the block of Kermanshah's Kouh-e-Sefid suddenly forms Kermanshah reef which reaches detrital facies of silt shales and siltstone and sandstones, which is equal with Amiran formation. Finally, Radiolarites sequence, located as a thrust on the Amiran formation, is observed as sedimentary sequence mentioned above; while in Kouh-e-Nesar's block, Gourpi formation is changed to Amiran formation by transitional boundary which in continuance this formation is finished by a disconformity to Kashkan's detrital formation that belongs to Eocene. Based on existing evidences, branchy function of Zagros thrust in the south of Kermanshah from Campanian causes sedimentary condition in two blocks which differ from each other.

Key words: Dynamic stratigraphy, Zagros, structural block, microfacies.

INTRODUCTION

Kermanshah is one of the western provinces of Iran. This area is in Northeast Zagros. Geological studies in Kermanshah area were done by different geological group different seasons, after the year 1966. According to existing reports in Iran National Oil Company, the first group of geologist with cooperation of Eshtoklin performed geological studies of this area in 1966 and recognized cretaceous Paleocene's sediment of Western Kermanshah (Bordman, 1987), (Bozorgnia, 1964). These studies show that units of upper cretaceous consist of KU1, KU2, KU3, KU4 and KU5 (Yousefirad, 1985). After that, Iran National Oil Company for the sake of economical interest in western area of the country performed some more exact and comprehensive studies. In addition, Oil Agent Company did sampling and studies in some parts of the areas for harmonizing expression related to the stratigraphic units. Braud (1970), in order to prepare his PhD thesis, did geological survey in the quadrangle of Kermanshah. This survey was performed by the guidance of Bolli et al. (1987). He divided quadrangle of Kermanshah from Southwestern to

Northeastern into four parts as follows:

- (i) Autochthonous Zagros
- (ii) Radiolaric thrust naps, Bistun limestone and ophiolites
- (iii) Tertiary units
- (iv) Metamorphic zone of Sanandaj-Sirjan or Hamedan zone.

On the other hand, in 1986, Mahmoud Fakhari, who did a study on stratigraphy and sedimentary environment of Kashkan formation in Khoramabad, Poldokhtar, Kermanshah and Eslamabad quadrangle, stated that the above formation is in southern parts and located compass of his study on Tal-e-Zang limestone and in north and northeastern areas on the Amiran or Tarbou formation. In addition, Fattane Hamrang (1967), in her MA thesis (1989), studied sequence of Paleocene's cretaceous of Western Kermanshah in Kabir Kouh, Imam Hasan anticlines, Mil-e-Sorhkh, Tang-e-Bejaro in Boli Seyah Kouh and Shah Zanjir by searching exciting microfossils. Adamsi et al. (1967) introduced some

assemblage zones of Oligostegina in Lurestan with each other. Also in the year 1994, Iran's geological organization provided Kermanshah's geological map with the scale of 1/100000 (Bordman, 1987), (Bozorgnia, 1964). This article represents the tectonic condition in the folded Zagros and crushed Zagros since Cenomanian to Maestrichtian in the Kermanshah Region is based on stratigraphy.

Geological and structural situation

Kermanshah is part of the structural zone of Autochthon Zagros in the boundary of Arabian and Iran plates (Figure 1). Big thrust of Zagros in Northeastern limb of Kouh-e-Sefid detaches Autochthone Zagros in southwestern from Radiolarite thrust in northeastern (Figure 2). But there is another thrust in the area which is located in Autochthone Zagros, and one of the most important is the thrust which is located in southwestern limb of Kouh-e-Sefid. Thrust of Kouh-e-Sefid, by its function in Maestrichtian, changed geological face of the area and caused the creation of two distinct structural blocks in northeastern Kouh-e-Sefid and southwestern Kouh-e-Nesar (Braud, 1971).

Stratigraphic units in geological formations in south of Kermanshah are explained as follows:

- (i) Cretaceous: consists of carbonate unit, which finally finishes the detrital formation of Amiran.
- (ii) Paleocene: consists of thick bed to massive neritic limestone equal to Tal-e-Zang formation.
- (iii) Eocene: consists of detrital sandstones and red conglomerate equal to Kashkan formation and white Doloments; and thick bed to massive limestone equal to Shahbazan formation.
- (iv) Miocene: consists of detrital units that are equal to upper red formation.
- (v) Pliocene: consists of conglomerate units that are equal to Bakhteyari's conglomerate formation (Braud, 1989).
- (vi) Quaternary: consists of old alluvium, Marly sediments, existing colluviums in slopes and alluvials, which are located in valleys and river bed area (Figure 3).

Dynamic stratigraphy

Basic differences in stratigraphy units between Kouh-e-Sefid and Kouh-e-Nesar blocks state thrust movement on Kouh-e-Sefid in the time of upper Cretaceous especially in Campanian-Maestrichtian. In order to know the exact time of thrust movement, there are some evidences as follows.

Lithostratigraphy

Lithology survey of two blocks in the time of Campanian

and Maestrichtian shows that there are basic differences between these two blocks. In Kouh-e-Sefid's block, after deposition of sedimentary sequence of Ilam formation, which consists of collection of marly limestone, there is deposition of massive collection of limestone beds. Then these beds with a sharp boundary reach the few thick Marly limestone's beds and after that, silty shall and limy sandstone; and immediately because of the existence of thrust in the area, radiolarite's beds were observed (Figures 4 and 5). But in Kouh-e-Nesar's block, after formation of Marly limestone of Ilam by transitional boundary, there is shall bed's collection of Gourpi formation. Gourpi formation was finished to Amiran detrital formation by transitional boundary. This formation reached Kashkan detrital formation in the shape of disconformity.

Comparison of microfacies

Sedimentary sequence of Ilam formation is completely similar to each other on Kouh-e-Sefid and Kouh-e-Nesar blocks and is mostly biomicrite (Wackstone). Nevertheless, in Campanian of Kouh-e-Nesar's block, the only microfacies are biomicrites that belong to Gourpi formation; and after that, detrital beds of Amiran formations are observed (Figure 3).

In Kouh-e-Sefid's block, Campanian microfacies are biomicrite and clay microspurite (packstone) that change to bandstone.

Biostratigraphy

Other differences between those two blocks refer to existence of different biozones. Table 1 shows that in Kouh-e-Nesar's block in Campanian-Maestrichtian; there are three biozones belonging to massive limestone that is immediately located on Ilam's limestone. While in Kouh-e-Sefid's block, there are two defined biozones.

Comparison of sedimentary environment

Evidences collection of lithology, biozonation and microfacies show the differences of sedimentary environment and sedimentary sequence of Campanian-Maestrichtian of mentioned areas. Some analyses of sedimentary environment of two blocks state are as follows:

Kouh-e-Sefid block

Campanian

Ilam formation in Kouh-e-Sefid's block has extra thick and stratigraphy of its sedimentation beginning from

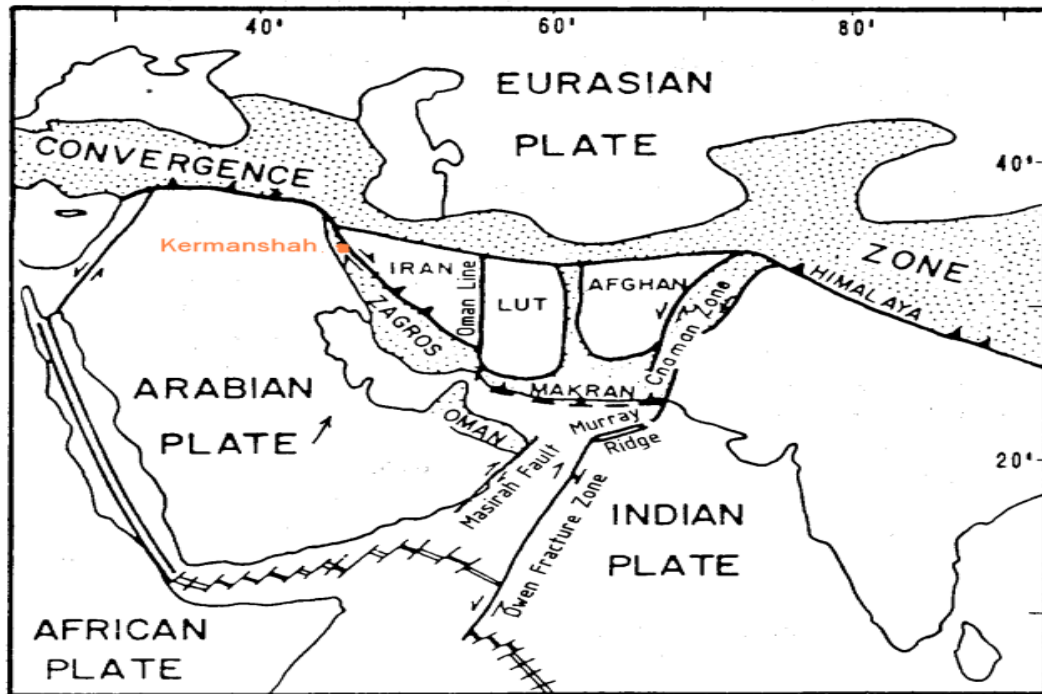


Figure 1. Sutures and blocks alps-Himalayan belt and structural position of Kermanshah.

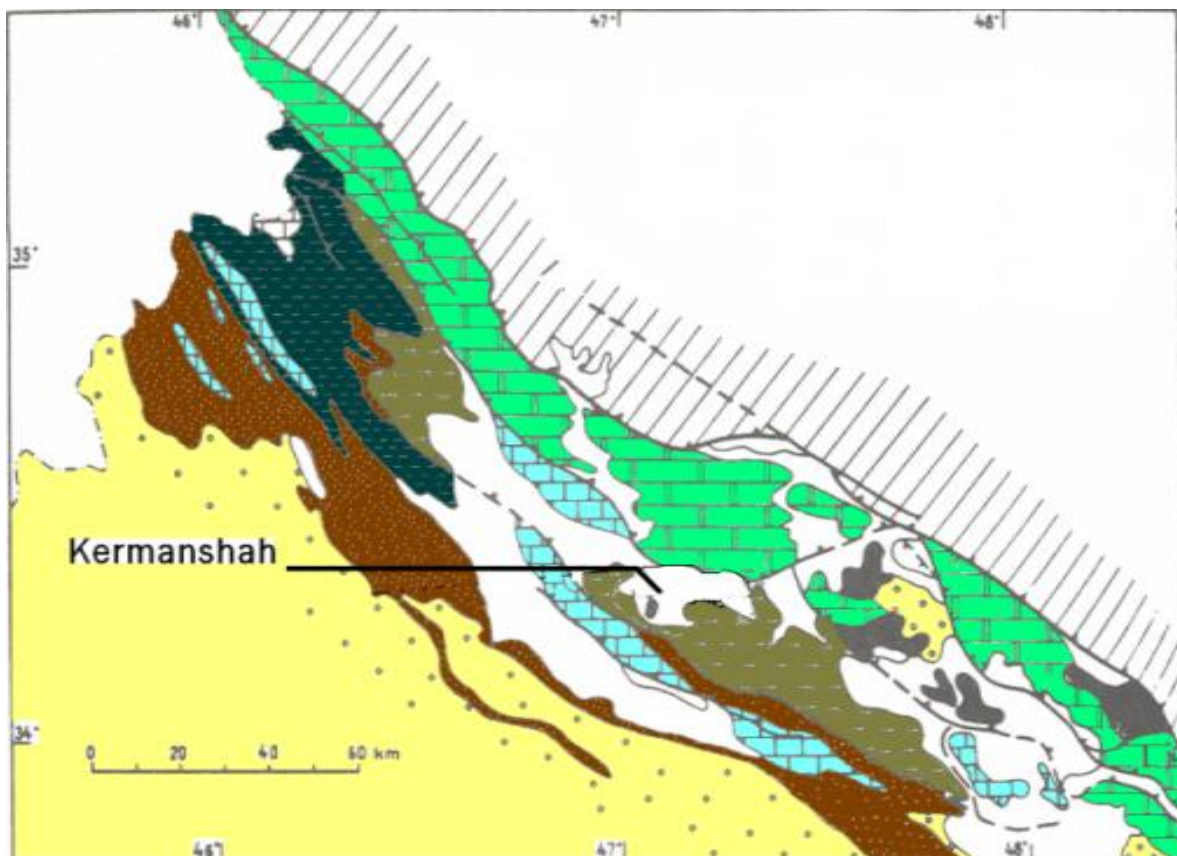


Figure 2. Position of Kermanshah in Zagros suture.

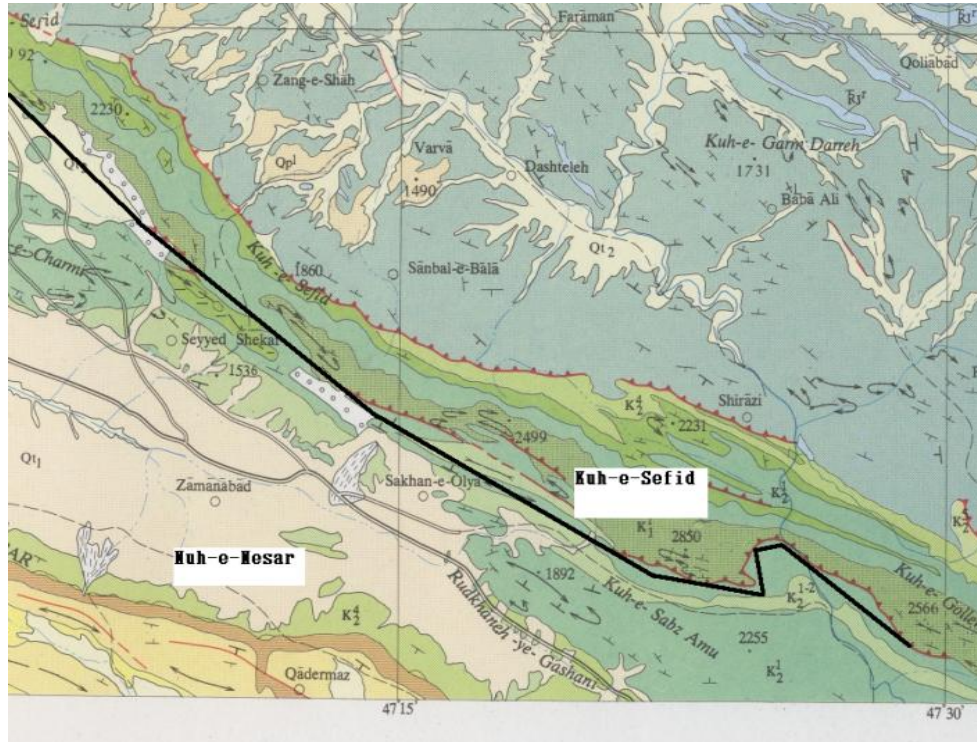


Figure 3. Geological situation of south Kermanshah and two blocks.

| Age | Formation | Stratigraphic Column | Lithology | Biozone | Microfacies |
|-------------------------------------|-----------|----------------------|---|-------------------------|------------------------|
| Paleocene | Kashkan | | | | |
| Middle-Upper Maestrichtian | Amiran | | Silty Sandstone, Sandstone and Limy Sandstone | Loftusia-Omphalocyclus | Graywake-Subarkose |
| Upper Campanian-Lower Maestrichtian | Gourpi | | Marle | Globotruncana stuarti | Biomicrite (Wackstone) |
| | | | Marly Limestone | Globotruncanita elevata | |
| Coniacian-Middle Campanian | Ilam | | Marle | | |
| | | | Marly Limestone | | |
| Cenomanian-Turonian | Sarvak | | Massive Limestone | - | - |

Figure 4. Lithology, biozonation and microfacies of the Kuh-e-Nesar block (scale, 1/20).

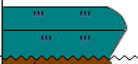

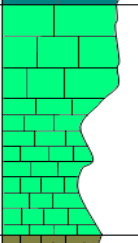

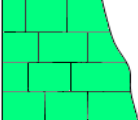
| Age | Formation | Stratigraphic Column | Lithology | Biozone | Microfacies |
|--|----------------------|--|---------------------------------|--|--------------------------|
| Jurassic | Radiolarite |  | | | |
| Upper Maestrichtian | Amiran |  | Sandstone and Silty Sandstone | - | Graywacke |
| Upper Campanian - Middle Maestrichtian | Kermanshah Limestone |  | Massive and Thick bed limestone | Siderolites calci Trapsoides | Sandstone |
| | | | Thin and Medium bed limestone | | Microsparite (packstone) |
| Coniacian-Middle Campanian | Ilam |  | Marly Limestone | Globotruncanita elevata Marginotruncana | Biomicrite (Wackstone) |
| Cenomanian Turanian | Sarvak |  | Massive Limestone | - | - |

Figure 5. Lithology, biozonation and microfacies of the Kuh-e-Sefid block (scale, 1/20).

Table 1. Comparison of exciting biozones in two blocks, Kouh-e-Sefid and Nesar.

| Block | Stage | Kouh-e-Sefid | Kouh-e-Nesar |
|----------------|--------|-----------------|----------------------|
| Maestrischtian | Upper | | Loftusia-omphalucyus |
| | Middle | | |
| Maestrischtian | Lower | Siderites calci | Globotruncana |
| | Upper | Topsails | |
| | Middle | Globotruncanita | Globotruncanita |
| | lower | | Elevata |

Coniacian up to Campanian. On the other hand, Coniacian deposits do not have any development compared to its previous and afterwards times. Being accompanied by the beginning of Santonian's stage, there is large part of deposited Ilam formation denoting stratigraphy accompanied by subsidence of sea floor; and also this case somehow continues up to Campanian.

Maestrischtian

At the end of Campanian, new positive epirogenic phase causes some attractive transformation to occur in this area. At this time, Kouh-e-Sefid's block is changed to

sedimentary basin with deposits of shallow area of the sea. The fluctuations depth of the sea in above sequence shows that sedimentary basin is located in sub tidal zones of shallow area of the sea up to the round of the continental slope with weak energy to average. Above environmental condition prepares the way for the growth of heap and local patch reefs. While laterally and in some points, collision with the mentioned reefs has sedimentary environment which consists of three parts: Lagoon, walls of reef and front of reef up to the shallow area of the sea. But this reef facies destroys, laterally.

Formation of above shallow facies, called limestone member of Kermanshah can be attributed to tectonic activities which result from continues movement of Arabia

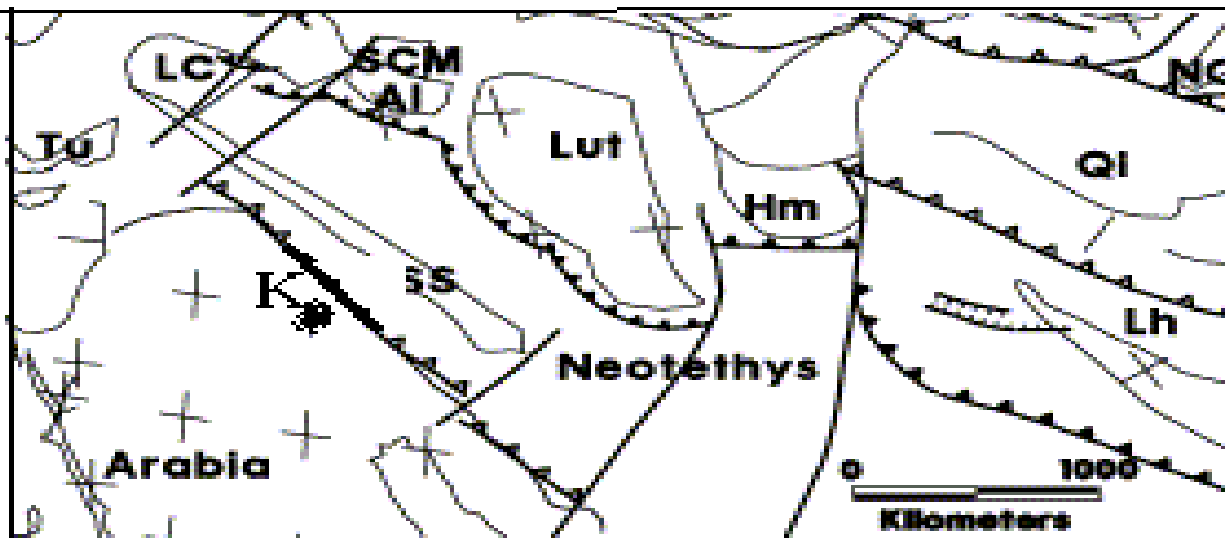


Figure 6. Structural position of Kermanshah area in Alps-Himalayan belt at Maestrichtian. K symbol is Kermanshah area (Golonka, 2004).

plate to the side of Iran plate.

However, above retrogressive sequence started from Campanian but under the influence of short progressive pressure (Negative epirogenic phase); above sequence changes to a comparatively deep facies with reef of Marly's limestone. But before long from the end of the lower Maestrichtian, other epirogenic phase complete retrogressive sequence results in deposition of sedimentary sequence of Amiran formation. In Kouh-e-Sefid, it is not distinguished exactly how the continues sediment sequence compressed to the other area, because it is located under the Radiolarites of Kermanshah with a fault contact; however, it shows the above fault does not have chronology. But based on this situation, it is younger than sedimentary time of Amiran formation.

Block of Kouh-e-Nesar

Stratigraphy section before the Campanian is nearly similar to block of Kouh-e-Sefid, but when accompanied by the beginning of Campanian stage, it shows different sedimentary condition to each other.

Campanian

Beginning of Campanian stage in this block is nearly assumed at the end of the Ilam formation. But before long when sedimentary basin of Ilam formation changes to environment for depositing sequence of shally and marly sediments, there is Gourpi formation. Beginning of sedimentary of these depositions in the entire zone is

under the influence of these conditions, resulting from deep basin.

Lower-middle maestrichtian

Sedimentary sequence of Gourpi formation can be divided into two parts: lower and upper. Its lower part (Campanian) is shall and upper part (lower Maestrichtian) organizes marly limestone with alternative of shall and marly limestone. The range of recent sedimentary of marly limestone is called limestone member of Imam Hasan. In this range, sedimentary sequences of Gourpi formation show sedimentary occurs in deep and calm environment. Sedimentary condition of Gourpi formation continues up to middle Maestrichtian but after this time sedimentary environment under the influence of the function of Tectonic phase of Laramide results from collision of Arabia and Iran's plates involved in some similar evolutions which occur at this time in Kouh-e-Sefid and other area. Its result is carbonate's sedimentary sequence of limestone member of Kermanshah and somehow it is chronological and laterally equal to limestone member of Imam Hassan in block of Kouh-e-Nesar.

However, it is attractive that sedimentary time of Amiran formation is nearly the same in two blocks and this event occurs after the middle Maestrichtian (Figure 6).

Paleocene

At the beginning of the Paleocene system/period under the influence of epirogenic phase at the end of the

cretaceous system/period, the area resaves continental condition which results in deposition of detritical sediments of Kashkan formation. These sediments overlay Amiran formation by a disconformity. In northwestern Kouh-e-Nesar, some points of Tal-e-zang formation are represented by detritical deposits of Kashkan.

DISCUSSION AND CONCLUSIONS

Based on the field research and the study of thin sections in south of Kermanshah, Ilam's Pelagic Marly of limestones overlays the Sarvak formation. Above deep facies with its monotonous environmental condition takes a long time and continues from Coniacian up to middle Campanian, followed by ending the above condition. From Campanian to Maestrischtian, the area involved in some special process, with two different facies can be distinguished from each other at this time. One of them is deposition in the block of Kouh-e-Sefid which consists of Neritic facies and the other is block of Kouh-e-Nesar which has deep facies and consists of Marly limestone that belongs to the deep area of the sea. Separated boundary of these two blocks is a young overthrust which continues parallel to Kouh-e-Sefid and from northwestern to southeastern. According to the stratigraphic section in block of Kouh-e-Sefid, this zone decreases the depth of basin under the influence of Tectonics' process which results from collision of Iran and Arabia's plates (Golonka, 2004). As a result, a shallow carbonate environment is produced by assemblage of benthic fauna and sometime develops local patch reef in suitable physical and chemical condition. Above sedimentary sequence is equal to Tarbur reef limestone in other area of Zagros and even by its speeding, this case is considered in all Tethys shores of Europe's south to Sanjab in upper Campanian up to Maestrischtian in different name. However, the beginning of regressive is manifested in which its result is accompanied by beginning of the formation of limestone member of Kermanshah. Above regressive sequence confronted a short retention phase which results from sedimentary basin fluctuations or function of area's faults. After reef limestone of Kermanshah, there appears beds of Marly limestone with Plagic facies, and after that regressive phase continues.

In western and southwestern of Kouh-e-Sefid, there is different situation, in which in this block at the beginning of Campanian, sea reached its maximum progressive. At this time, existing big massive sedimentary of shall-Marly and Marly limestone is the singe of basin subsidence, which continues up to Maestrischtian. In this zone, limestone member of Imam Hasan overlays on Gourpi

formation, after that there is few thick Marly, and shall which reach sandstones and selststone of Amiran formation during the transitional passing. Above mentioned evidences result from Laramid orogenic phase activities, which obey the other above blocks. The results of this orogenic phase activities are folding, thrusting, basin uplift, detritical areas that come up and produce a lot of detritical materials such as siltstone and sandstone, which above sedimentary transports and again deposits in basin. This phenomenon occurs in Iraq in patterns.

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